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ABSTRACT

A study investigated the relationship between shared communication links and the process of organizational innovation in a privately owned medical clinic providing comprehensive medical care to children and adults. Participants were the physicians and physician assistants employed at the clinic. Data were collected through questionnaires before and after the introduction of the innovation. The study hypothesized that the type and strength of communication links between individuals may determine the likelihood with which an individual will adopt an innovative idea. The hypothesis was not supported; several reasons may account for the lack of significant findings: (1) the innovation introduced was not salient for all members of the organization; (2) innovations are not championed in health care settings; (3) the clinic, like many health care settings, can be classified as a loosely coupled system and characterized as decentralized with a relative lack of coordination; and (4) participants in the study were unable to identify the primary content of their conversation with others and therefore could not identify multiplex links. (Tables of data are appended.) (SRT)

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An Over Time Analysis of Relationship Multiplexity and Innovation

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An Over Time Analysis of Relationship

Multiplexity and Innovation

Abstract

This study investigated the relationship between shared communication links and the process of organizational innovation. It was hypothesized that the nature and content of an individual's communication links with others could predict individual innovation adoption. Seven different communication link types (e.g., uniplex innovation, uniplex social, uniplex work, biplex work/social, biplex work/innovation, biplex social/innovation, multiplex work/social innovation) were identified as predictors of individual innovation adoption. Adoption behavior was assessed by recording both rate of adoption and extensiveness of adoption over a 90-day time period. Results of a regression analysis provided no support for the hypotheses. The lack of results is attributed to the salience of the innovation introduced and to the conceptualization and breakdown of communication link types.

Organizations must be capable of innovation if they are to be excellent or profitable, (Kanter, 1983; Peters & Waterman, 1982; Tornatzky, Eveland, Boylan, Hertzner, Johnson, Roitman & Schneider, 1983). The concern with innovation is evident in American industry because increased competition from foreign markets, especially Japan, has decreased the international market-share of the United States (Ouchi, 1981). In order to remain competitive, domestic businesses have experienced pressure to more rapidly and frequently innovate.

Any idea, practice or object that is perceived as new is an innovation. Rogers (1972, 1983) asserts that any theory of organizational change and innovation must consider how innovations are diffused throughout the organization. Diffusion is the process by which an innovation is communicated through certain formal and informal channels over time among members of a social system (Rogers, 1983). As such, innovation and subsequent change are fundamentally communication problems. Individuals learn of new ideas by talking with others.

When one individual communicates with another on a regular basis a communication link is created. Farace, Monge, & Russell (1977) suggest that three different types of messages may be communicated in a single, established, link. In this paper, these

three message types are investigated as predictors of individual innovation adoption. Specifically, does the content of an individual's communication link with another dictate the dissemination and innovation information and thereby the eventual adoption of an innovative idea?

Innovation and Communication Links

To date, over 3,000 innovation studies have been conducted (Rogers, 1983). Although an impressive amount of empirical research has been carried out, much remains to be learned about the conditions for innovation (Biogness & Perreault, 1981; Kimberly & Evanisko, 1981). The desire to explicate innovation in organizations has been considerable, but the parsimony of such explications has been wanting. Previous research on innovation diffusion and adoption has proven problematic in three major ways: (a) much innovation research emphasizes only two mutually exclusive roles or functions an individual adopts when disseminating innovative information, (b) individuals, rather than communication links between individuals, have been the unit of analysis, and (c) the data reported inherently lack demonstrable validity (Rogers, 1979, 1983; Downs & Mohr, 1976; Mohr, 1969).

Communication Roles

Research examining the diffusion of innovations has traditionally identified only two mutually exclusive roles which an individual may adopt during the dissemination of new ideas:

linkers or non-linkers. Linkers are individuals who perform a communication-linking function among groups in an organization (Jacobson & Seashore, 1951; Schwartz & Jacobson, 1977; Weiss & Jacobson, 1955), while non-linkers occupy a role of general seclusion from others in the network. These two roles are generally perceived as fairly constant entities, determinants of one's status in a communication network, and as predictors of an individual's learning of new ideas and ultimate adoption of an innovation.

Recent work (Albrecht & Ropp, 1984; Rogers, 1983) suggests that individuals do not occupy specific roles during innovation diffusion and that individuals learn of new ideas by virtue of their shared communication links with others. Albrecht & Ropp (1984) found that the largest proportion of discussions about innovative ideas occurred when information about work and social information was also exchanged. As such, identification of communication role may be inadequate for studying innovation diffusion. Identifying shared communication links provides a more dynamic, and perhaps more accurate, means for investigating innovation diffusion.

Individuals as Units of Analysis

A certain degree of individual emphasis is evident in much innovation diffusion research (Rogers, 1983). Individuals who do not readily adopt are seen as the primary cause for system-wide rejection of an innovation. These late-adopting individuals are often pejoratively characterized as traditional, isolated, and

resistant to change (Rogers, 1983). Further, the identification of individuals as the cause of system-wide rejection of innovation implies that individuals are the unit of analysis. Focusing upon the individual ignores the importance of the communication transaction which occurs between individuals.

Validity of Data

Two problems have surfaced in innovation research: (a) data are generally collected at a single point in time and (b) innovation researchers have relied primarily upon recall data. Taylor, Farace, & Monge (1976) assert that much of the existing innovation research is static with data collected at a single point in time. At a minimum, studies of the diffusion process should utilize multiple data collections, over time, to track individual adoption rates. Multiple measurements allow researchers to examine the impact of completely unexpected events on planned dissemination activities (Rogers, 1983).

Innovation research has relied typically upon recall data to determine rate of adoption. Respondents' ability to accurately recall adoption has proven problematic with regard to validity of the data. Rogers (1983) claims that dependence upon recall data is a methodological enemy in studying the communication of innovations. In a study of farmers, Coughenour (1965) found that hindsight is not reliable or valid when the typical respondent is describing his or her adoption behavior.

Rationale for This Study

This study will: (a) identify and explore additional communication roles an individual could perform during the dissemination of innovative ideas, (b) correct the problem of blaming individuals for system-wide rejection of an innovation, and (c) enhance the validity of innovation data.

Individuals in organizations have more than two communication roles they can adopt. Farace et al. (1977) have noted that individuals in organizations may communicate in three content areas. They contend that innovation, production, and maintenance are three areas of message content which exist in an organization. Different combinations of these message networks may be used by individuals to communicate innovative ideas. Albrecht and Ropp (1984) have investigated the nature of communication links between individuals and have found that certain types of links give rise to the spread of innovation-related messages. They have found that communication about innovation-related messages occurs through the multiple links an individual has with another. That is, individuals are more likely to report that information about innovative ideas was shared with another if information about work and personal issues was exchanged at the same time (Albrecht & Ropp, 1984). This study extends the research done by Albrecht & Ropp and identifies seven message choices individuals may make when they disseminate new information to others. The strength or

frequency with which these choices are executed is also investigated.

A communication perspective could remove bias against the individual if the relationship between two communicators was explored. Coleman (1958) has noted that the focus on the individual as the unit of analysis in innovation research is often due to the assumption that if the individual is the unit of response he or she must also be the unit of analysis. Previous research on innovation has identified roles (e.g., laggard, innovator) assumed by individuals during the process of innovation without making clear how these new ideas are communicated between individuals. Rogers and Bhowmik (1971) have asserted that a great deal is known about the characteristics and roles of individuals who are relatively early or late in their adoption of new ideas, but that little is known about the communication relationships involved in innovation diffusion. If relationships are studied, the individual not longer becomes the unit of analysis. Rather, the dynamic interaction between two individuals becomes the focus of study. This dynamic interaction is represented as a communication link.

A final rationale for this study was to correct problems with validity of innovation data. This project was designed to collect over-time data on innovation adoption. Data were longitudinally collected while an innovation occurred, thereby alleviating any problems with recall.

Hypotheses

Two theoretical perspectives (e.g., conformity theory and communication structure) were identified as a framework for investigating the relationship between shared communication links and the process of innovation.

Independent Variables

Three major message links were identified for this study. These three message links were expanded into seven different types of links. One type of communication relationship is comprised of multiplex message links (Mitchell, 1969; Rogers & Kincaid, 1981). Individuals in organizations share a multiplex communication link when they communicate work, social, and innovative ideas with each other. A second type of communication link is also possible. Individuals may share a weak multiplex (Albrecht & Ropp, 1984) or biplex link with another. These biplex links may contain three types of messages: (a) innovation and social messages, (b) work and innovation messages, and (c) work and social messages. Individuals may have only one, uniplex communication link with others. Either innovative information, work information, or social information may be communicated to another.

The type and strength of communication links between individuals may determine the likelihood with which an individual will adopt an innovative idea. Rogers (1983) has developed a method for categorizing adoption, which is based on the assumption

that adopter distributions closely approach normality. The normal distribution can be divided into five adopter categories: (a) innovators or pioners, (b) early adopters, (c) early majority, (d) late majority, and (e) laggards. Rogers' (1983) model is used to make predictions about communication link type and adoption.

Figure 1 about here

Multiplex links. Individuals with multiplex communication links may be early adopters of an innovative idea. The advantages of multiplexity lie in the strengthening of social control (Mitchell, 1969) and of social integration (Kapferer, 1969; Wiemann, 1983). Both of these advantages come into play as an individual becomes exposed to, and chooses to implement or reject, an innovative idea. It has been argued that individuals may exert more control over others with whom they are multiplexly tied (Kapferer, 1969). As such, an individual with multiplex links to others is likely to conform to the standards set by those individuals with whom the links are shared.

Multiplex links are indicative of social integration. People who are linked in multiple ways are better able to develop collegial relationships abecause they have more information about each other (Albrecht & Ropp, 1984). The process of exchanging information may reduce uncertainty. When people are less uncertain about others, they may be more willing to share innovative ideas.

Biplex links. Individuals with biplex communication links may adopt an innovation at varying rates, depending upon the nature of the biplex links shared with another. When an innovation is risky, the reinforcement and support provided through social links takes on increased importance (Becker, 1970). Although one may hear of a new idea through innovation links, it is perhaps the supportive social links which encourage adoption. As such, individuals with biplex social/innovation links will be among the early majority of individuals to adopt a new idea.

Organization members with work/innovation links or work/social links may, on the other hand, be among the late majority in their adoption of an innovative idea. Individuals with these biplex work/innovation links may be conflicted by equivocal information by virtue of the content of the links. While the function of innovation links is to promote new ideas, work links are used to communicate the status quo (Farace et al., 1977).

Individuals with biplex work/social links may also be among the late majority of individuals to adopt a new idea. Later adoption is likely because there would be no links in the innovation network. It is difficult to adopt an idea if one has no immediate access to it.

Uniplex links. Individuals with uniplex links may be either pioneer adopters or laggards, depending upon the nature of their communication link with another. If a person shares a uniplex innovation link, it is likely that s/he will be an adoption pioneer.

Rogers and Kincaid (1981) have noted that one's behavior is part
a function of the communication networks in which he or she is a
member. Pioneer adopters are known for being venturesome and for
their ability to be daring and risky (Rogers, 1983). Individuals
with uniplex innovation links to others may pioneer adoption, sin
risk is apparently a norm for this group. In this case the
motivation to conform would be high; individuals in this group wh
did not conform would risk rejection from the only organizational
links they had.

Individuals with uniplex social or work links are likely to b
laggards by virtue of their very limited exposure to new ideas.
It is difficult to adopt a new idea if one has no access to it.
When a new idea does reach an individual with uniplex work and
social links, it is likely that everyone in the system has had
prior exposure to the idea.

Dependent Variables

This investigation explores adoption from two different
perspectives by looking at both rate of adoption (ROA) and
extensiveness of adoption (EOA). Rate of adoption is defined as
the time an individual implements an innovative idea.
Extensiveness of adoption is characterized by the number of times
an individual actually used an innovation while it was being
disseminated.

Given the above arguments, the following hypotheses are
posited:

H_1: Those with uniplex innovation links will be pioneer adopters. They will be followed by individuals with multiplex links who will adopt in the early majority, and individuals with biplex work/innovation and work/social links who will adopt with the late majority. Those with uniplex social or work links will be laggards.

H_2: Individuals with different link types will have variable EOA. Those whose greatest proportion of links are uniplex innovation will be the most frequent users of an innovation. Individuals whose greatest proportion of links are multiplex will be next and will be followed by those with biplex social/innovation, biplex work/social, and biplex work/innovation. Individuals whose greatest proportion of links are uniplex work links will be the least frequent users of the innovation.

H_3: An individual's ROA will vary depending upon the strength of communication links shared with others. Rate of adoption will occur in an order identical to that described in H_1.

H_4: The strength of one's communication links will affect the number of times one chooses to implement an innovation. EOA will occur in an order identical to that described in H_2.

Methodology

The Organization

The organization used for this research was a medical clinic in the northern Rocky Mountains, located in a city of approximately 50,000 population. The clinic is a privately-owned corporation which provides comprehensive medical care to children and adults.

The Subjects

Respondents were physicians and physician assistants (n=67) employed at the Clinic. The sample was evenly divided between the two groups, and was almost evenly divided by sex. The mean age was 38 ($\underline{s}$ = 9.72) and the average length of time employed at the Clinic was 6.19 years ($\underline{s}$ = 1.00). Nearly all were Caucasian. Ninety-seven percent had completed high school and 58 percent had completed college. Fifty-two percent had completed advanced training in medicine, psychology or podiatry.

Procedures

Data were collected in three stages. First, data for the independent variables (e.g., link type) were collected at two points in time. Respondents were given a questionnaire which contained a roster of all members of the organization. They were asked to read through the list of names and indicate how often they had exchanged work, social, or innovative information with each person on the roster during the past two weeks. Questionnaires were distributed

two weeks later. The same procedures for data collection were followed.

Next, after all data for the independent variables were collected, data for the dependent variable, innovation adoption, were collected over a 90-day (13 week) period. Dependent variable data were gathered the day after a product-process (Zaltman, Duncan, & Holbeck, 1973) innovation was introduced to the clinic staff. The innovation involved a change in the clinic's billing process, and consisted of a pocket-sized booklet containing daily log sheets on which a physician's hospital work could be recorded. Data generated on the log sheets were collected on a daily basis so that the rate and extensiveness of the adoption could be studied.

During the final stage of data collection, participants responded to a follow-up questionnaire. This questionnaire was distributed 14 weeks after the innovation was introduced. All data (e.g., independent and dependent variables) were gathered prior to distribution of this questionnaire, which contained qualitative and quantitative questions designed to assess individual motivations for innovation adoption (e.g., pay increase, power, superior influence, administrative repercussions). These questions were asked as rival hypotheses.

Measurement

The data were analyzed using stepwise multiple regression (SPSSX, 1983) to predict whether type of link had an affect on adoption. Before data were analyzed using the above procedures, link type and link strength scores were calculated.

Link type. Link type was determined by tabulating the number of links an individual reported. Seven different link types were possible and individuals received seven scores. A link percentage score was calculated by dividing the number of reported links for each link type by the total number of links reported:

$$L = \frac{n}{\Sigma n}$$

Where: L = percentage of Links for each link type
n = number of links for each link type (work, social, etc.)
Σn = total number of links (for all link types)

Link strength. Link strength was also calculated as a percentage. Frequency of communication was summed for each of the seven link types and each respondent had seven strength percentage scores. These scores were multiplied by the number of reported links for each link type. This number was then divided by the product of the maximum link strength and the maximum number of contacts possible (e.g., the number of respondents in the study):

$$S = \frac{f \times n}{F \times n}$$

Where: S = strength percentage
f = frequency of communication for each link type
n = number of links for each link type (work, social, etc.)
F = maximum link strength (F = 480)
N = highest number of contacts possible (N = 67)

Adoption. Adoption was measured two ways. Rate of adoption (ROA) defined as the relative speed with which an innovation is adopted (Rogers, 1983). For this study, ROA was determined by the date of individual first use of the innovation. ROA was observed over a

three-month (90 day) period. Hence, individuals received a rate of adoption score from 1 to 90 depending upon the day of first use.

Extensiveness of adoption (EOA) was included as a second dependent variable. EOA was determined by the total number of days an individual used the innovation. An individual score of 1 to 90 was possible and depended upon the total number of days the innovation was used.

Results

Network Stability

Results of a network stability correlation indicate moderate stability of the networks across time. The strongest correlation was found in the biplex work/social links followed by uniplex work links, and multiplex links. With the exception of multiplex work/social/innovation links, all other links containing an innovation component had very low correlations (Table 1).

Insert Table 1 about here

The low stability of innovation links can be accounted for by the paucity in reported links of this type. Less than 15% of the respondents reported having uniplex innovation or biplex social/innovation links. While generally half the sample (56%) reported biplex work/innovation links, the number of links reported by each member was very low, resulting in instability over time.

Adopters

Demographic data. According to the model of adopters proposed by Rogers (1983), 28% were early adopters, 12% were among the late majority, and 16% were laggards with regard to their adoption time ($\bar{X}$ = 40.25, s = 27.97). These calculations assume that adopter distributions approach normality and can be placed on a normal frequency distribution by determinating mean and standard deviation. Based upon Rogers' (1983) formula for calculating rate of adoption, no one in the sample of adopters qualified as an innovator. Forty-one percent (n = 13) of the adopters used the innovation only once; average innovation use was 2.34 (s = 5.07).

Link data. Those adopting the innovation reported a total of 2,994 communication links. Of these reported links, 38% were uniplex work links, 28% were biplex work/social links, 17% were miltiplex links, and 11% were uniplex social links. Eighty-six percent of the adopters reported no uniplex innovation links, and 89% reported no social/innovation biplex links. Over half (51%) reported no work/innovation biplex links (Table 2).

Adopters communicated with others a total of 66,019 times, 36% of the link strength for the entire sample. The strongest links were multiplex links, followed by biplex work/social links and uniplex work links. The weakest links were uniplex innovation and biplex social/innovation links (Table 3).

Insert Tables 2 and 3 about here

Because 52% of the sample did not adopt the innovation and because t-tests failed to distinguish differences (with the exception of uniplex social links) between adopters and non-adopters, all non-adopters were dropped from subsequent analysis. If non-adopters remained in the sample, consequent analysis would identify only those variables which best predict adoption as opposed to non-adoption, rather than predicting rate of adoption (ROA) or extensiveness of adoption (EOA).

Results of Hypotheses

Link type and ROA. The analysis of H_1 produced a statistically significant correlation coefficient although not in the predicted sequence. With the exception of biplex work/innovation links ($r = -.39$, $p < .05$) zero-order correlations of all other variables with rate of adoption were non-significant (Table 4). When entered with the other variables in a regression equation predicting ROA, only biplex work/innovation links were significant ($r = -.39$, $p < .05$). The following regression equation was produced:

$$ROA = 46.39_a\ (.13_{innovation}) + (-.20_{work/social/innovation}) + (.08_{social/innovation}) + (.13_{work/social}) + (-.39_{work/innovation}) + (-.14_{social}) + (.17_{work})$$

($R^2 = .15$).

Link type and EOA. The analysis of H_2 yielded no support for this hypothesis. Zero-order correlations of all variables with extensiveness of adoption were non-significant (Table 5). When all variables were regressed upon EOA none were significant ($p > .15$):

$EOA = .91_a + .00_{innovation} + (.08_{work/social/innovation}) + (.02_{social/innovation}) + (.30_{work/social}) + (.17_{work/innovation}) + (.21_{social}) + (-.25_{work})$ ($R^2 = .08$).

Link strength and ROA . Correlations of all variables with rate of adoption were non-significant (Table 6). When the variables were regressed upon ROA no significant regression coefficients emerged ($p > .15$):

$ROA = 42.73_a + (-.21_{innovation}) + (-.17_{work/social/innovation}) + (.02_{social/innovation}) + (-.19_{work/innovation}) + (-.19_{work/innovation}) + (-.27_{social}) + (.16_{work})$ ($R^2 = .08$).

Link strength and EOA. The analysis of H_4 yielded no support for this hypothesis (Table 7). When the variables were regressed on EOA, none were significant ($p > .15$):

$EOA = 3.65_a + (-.15_{innovation}) + (-.02_{work/social/innovation}) + (-.09_{social/innovation} + (.01_{work/social}) + (.17_{work/innovation}) + (x29_{social}) + (-.13_{work})$ ($R^2 = .08$).

Insert tables 4, 5, 6, & 7 about here

Rival Hypotheses

When the rival hypotheses were tested with regression analysis, three significant coefficients were found. Two were found when weekly hours worked ($r = .54$, $p < .01$; $\beta = .54$, $p < .01$) and input into innovation development were regressed upon rate of adoption ($r = .61$, $p < .05$; $\beta = .48$, $p < .05$) (Table 8); the third when input into

innovation development was regressed upon extensiveness of adoption ($r = -.79$, $p < .001$; $\beta = -.79$, $p < .001$) (Table 9).

Insert Tables 8 & 9 about here

Discussion and Implications

The purpose of this study was a) to identify and expand upon the communication roles an individual may adopt during the dissemination of innovative information, b) to establish the communication link, rather than the individual, as the unit of analysis, and c) to enhance the validity of innovation data. The hypotheses in this study were not supported. Several reasons may account for this lack of significant findings.

First, the innovation introduced was not salient for all members of the organization. Although the innovation introduced in this study fulfilled all the requirements for successful adoption (Rogers, 1983), it did not seem important enough to warrant adoption. In the post-hoc questionnaire, which asked about the innovation's salience, several physicians responded, "Please let me know about pay increase--I didn't notice" or, "I thought that most, if not all, of my patient charges were already being credited to my booking" or, "I think most of my billing is complete without this." Simply, the innovation was not particularly salient for physicians. The innovation was also not salient to physician assistants. Their

adoption was subsequent to physician adoption of the innovation. Assistant responses on the salience question were uniform and reflected in the comment, "I had no choice in the matter. My doctor adopted, and so did I."

Next, the lack of significant results may lie in the type of organization studied. Innovativeness is not championed in health care settings. Rogers (1983) has noted that there has been strong opposition to innovativeness in organized medicine. Medicine has encouraged adoption of new techniques of treatment but has long maintained a stringent ideology opposing innovations in the organization (Rogers, 1979). This argument, coupled with the perception of innovators as those who threaten the organization's stability and status quo (Bettinghaus, 1980) provides a poor prognosis for innovativeness in medical settings. This notion is illustrated in the present study. Of the total reported communication links, only 1% were comprised solely of links containing innovative information. When innovative information was exchanged, it was communicated with either work information (5% of all links) or with information about work and social matters (17% of all links). Innovative ideas were not frequently exchanged in the organization studied. Perhaps if innovation is the central focus of an investigation, an organization where innovativeness is rewarded (e.g., high technology) should be selected as the research site. It is likely that the number and frequency of innovation links of all types would be greater than the innovation links reported in the present study.

Third, the structure of the organization may have accounted for the lack of significant results. The clinic, as many health care settings, can be classified as a loosely coupled system and characterized by a relative lack of coordination and decentralization (Weick, 1979). Berkowitz has identified many health care clinics as "practices which are nothing more than a collection of individuals who share the same facility. Each physician or department operates independently and personal gain is the primary objective" (1984, p. 34). While loosely coupled systems appear to adapt easily to change and innovation (Weick, 1982), the organization studied was disjointed and therefore unlikely to reap the benefits which loose coupling provides. Communication in health care systems may be unpredictable or sporadic and not easy to predict with any certainty. Communication patterns could be unstable and irregular, making measurement of communication links difficult.

Finally, the identification of multiplex links was difficult for respondents. During data collection, several respondents expressed concern over their inability to distinguish the primary content of their conversations with others. Burt (1983) notes that content confusion is common in network data. He claims that it is often difficult for respondents to determine where and when one type of relational content stops and another begins (Burt, 1983). If respondents are unable to determine the nature of their links, it is likely that the data gathered are not an accurate representation of individual communication patterns.

In summary, the lack of significant results may have been due to the limited salience of the innovation, the type of organization studied, the structure of the organization, and respondents' difficulty with identifying the nature of their communication links.

Despite the limitations, this study has several contributions. First, communication role was conceptualized, suggesting that change occurs within the context of personal communication relationships. Second, this study explored how the comparison of individual communication links can affect an individual's innovativeness. Few network analyses have shown that multiplex links can differ from uniplex links. Not only was the difference between these links examined, a third type (e.g., biplex) of communication link was also analyzed. Third, a concrete behavioral manifestation of innovation, measured in "real" time, served as a dependent variable in this study. Adoption behavior was measured over time as it happened, without reliance upon recall data. Finally, individual adoption was measured in two potentially convergent ways. Both rate of adoption and extensiveness of adoption were used as dependent measures.

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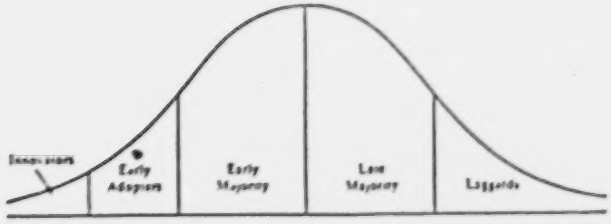

Adopter Categorization	Link Type
Innovators	Uniplex innovation
Early Adopters	Multiplex
Early Majority	Biplex social/innovation
Late Majority	Biplex work/innovation Biplex work/social
Laggards	Uniplex social Uniplex work

Figure 1. Adopter Categorization and Link Type (bell curve from Rogers, 1983, p. 247)

Table 1. Correlations Between Wave 1 and Wave 2 on Number of Links

	r^2
work	.62
social	.56
innovation	-.05
work + social	.80
social + innovation	.18
work + innovation	.21
work + social + innovation	.60

Table 2. Descriptive Data Comparing Adopters and Non-Adopters on Link Data

	Adopters		Non-Adopters	
	n	% of Total Links	n	% of Total Links
work	1,137	.38	1,294	.35
social	320	.11	512	.14
innovation	21	.00	40	.01
work + social	851	.28	982	.27
social + innovation	30	.00	11	.00
work + innovation	127	.05	201	.05
work + social + innovation	508	.17	629	.17
TOTAL	2,994	.99	3,669	.99

Table 3. Descriptive Data Comparing Adopters and Non-Adopters on Link Strength Data

	Adopters		Non-Adopters	
	n	% of Total Links	n	% of Total Links
work	8,027	.12	10,939	.13
social	1,034	.02	2,126	.03
innovation	24	.00	98	.00
work + social	20,286	.30	31,888	.39
social + innovation	166	.00	144	.00
work + innovation	1,400	.02	1,606	.02
work + social + innovation	35,082	.53	34,324	.42
TOTAL	66,019	.99	81,125	.99

Table 4. Correlation Matrix for Regression of Link Type on Rate of Adoption

	innovation	work + social + innovation	social + innovation	work + social	work + innovation	social	work	ROA
innovation	1.000							
work + social + innovation	-.053	1.000						
social + innovation	-.063	-.185	1.000					
work + social	-.374*	-.050	-.196	1.000				
work + innovation	.089	.329	-.087	-.533**	1.000			
social	.117	-.254	.471**	-.206	-.254	1.000		
work	-.482**	-.536**	-.155	.084	-.283	-.365*	1.000	
ROA	.091	-.306	.111	.112	-.386*	-.039	.271	1.000

* p < .05

** p < .01

Table 5. Correlation Matrix for Regression of Link Type on Extensiveness of Adoption

	innovation	work + social + innovation	social + innovation	work + social	work + innovation	social	work	EOA
innovation	1.000							
work + social + innovation	-.053	1.000						
social + innovation	-.063	-.185	1.000					
work + social	-.374*	-.050	-.196	1.000				
work + innovation	.089	.329	-.087	-.533**	1.000			
social	.117	-.254	.471**	-.206	-.254	1.000		
work	-.482**	-.536**	-.155	.084	-.283	-.365*	1.000	
EOA	-.115	.070	-.036	.298	-.036	.144	-.224	1.000

* p < .05

** p < .01

Table 6. Correlation Matrix for Regression of Link Strength on Rate of Adoption

	innovation	work + social + innovation	social + innovation	work + social	work + innovation	social	work	ROA
innovation	1.000							
work + social + innovation	-.098	1.000						
social + innovation	-.076	-.087	1.000					
work + social	-.114*	-.960**	-.067	1.000				
work + innovation	.076	.349*	-.087	.331	1.000			
social	.154	-.129	.138	-.098	-.171	1.000		
work	-.103	-.751**	-.124	.810**	.225	-.227*	1.000	
ROA	-.195	.061	-.045	.079	-.277	-.147	.091	1.000

* $p < .05$

** $p < .01$

Table 7. Correlation Matrix for Regression of Link Strength on Extensiveness of Adoption

	innovation	work + social + innovation	social + innovation	work + social	work + innovation	social	work	EOA
innovation	1.000							
work + social + innovation	-.098	1.000						
social + innovation	-.076	-.087	1.000					
work + social	-.114	.960**	-.067	1.000				
work + innovation	.076	.349**	-.087	.331	1.000			
social	.154	-.129	.138	-.098	-.171	1.000		
work	-.103	.751**	-.124	.810**	.225	-.229	1.000	
EOA	-.105	-.064	.053	-.016	-.122	.228	-.194	1.000

* $p < .05$

** $p < .001$

Table 8. Correlation Matrix for Regression of Rival Hypotheses on Rate of Adoption

	Superior Influence	Input into Innovation Development	Weekly Hours Worked	Education	Pay Increase	ROA
Superior Influence	1.000					
Input into Innovation Development	.193	1.000				
Weekly Hours Worked	.456*	.211	1.000			
Education	-.488	-.151***	-.727	1.000		
Pay Increase	.338	.064	.313	-.332	1.000	
ROA	.347	.389**	.542	-.412	.217	1.000

* $p < .05$

** $p < .01$

*** $p < .001$

Table 9. Correlation Matrix for Regression of Rival Hypotheses on Extensiveness of Adoption

	Input into Innovation Development	Superior Influence	Length of Employment	Department Worked In	Education	Pay Increase	EOA
Input into Innovation Development	1.000						
Superior Influence	.216	1.000					
Length of Employment	-.347	-.446*	1.000				
Department Worked In	-.011	.053	-.253	1.000			
Education	-.144	-.594**	.167	.120	1.000		
Pay Increase	.083	.362	.053	.149	.288	1.000	
EOA	-.794***	-.339	.247	-.115	.165	-.122	1.000

* $p < .05$

** $p < .01$

*** $p < .001$